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## A Review of the Oriental Toads of the Genus *Ansonia* Stoliczka

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### INTRODUCTION

The genus *Ansonia* Stoliczka has been distinguished from *Bufo* on the basis of larval and adult morphological characters, some of which are clearly related to the profound ecological differences between these genera (Inger, 1954). Conspicuous among these diagnostic and adaptive characters of *Ansonia* are: membranous webbing; slender body and long legs; streamlining of tadpoles; sucker-type oral disk of tadpoles; and relatively large and pigmentless ova. These modifications adapt *Ansonia* to a life in and along swift, rocky streams. Weak subarticular tubercles and lack of parotoid glands also distinguish *Ansonia* from *Bufo*, though they do not seem to be part of the adaptive complex.

Dr. Joseph Tihen, University of Notre Dame, has examined most of the species of *Ansonia* included in this paper in connection with his own studies on Bufonidae and has called attention to several other differences between *Ansonia* and *Bufo* (Tihen, 1960). Most of the species of *Ansonia* have very long tensor fasciae latae, whereas in *Bufo* this muscle is short. The quadratojugal, which in *Bufo* always touches the maxilla, is reduced in *Ansonia* and rarely reaches the maxilla. Finally, a well-developed sharp ridge crosses the posterior portion of the parasphenoid in *Ansonia* but is absent in *Bufo*.

The tadpoles of *Ansonia* differ radically from those of *Pedostibes* Günther and *Pelophryne* Barbour, the other abundant genera of Malaysian bufonids. The tadpole of *Pedostibes* has the subspherical body form and non-specialized oral disk of *Bufo* larvae. Larval *Pelophryne*, however, are extremely specialized for rapid development in very small pools of rain water; they apparently subsist dur-

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ing the entire larval period on yolk, have a degenerate oral disk, and lack a spiracle (Inger, 1960).

Adult *Pelophryne* differ from *Ansonia* in having the coccyx fused to the sacrum (movable joint in *Ansonia*) and provided with a broad, horizontal, flattened plate (coccyx laterally compressed in *Ansonia*). In addition, the hands and feet of *Pelophryne* have a peculiarly thickened web. Adult *Pedostibes* differ from *Ansonia* in the possession of distinctly webbed outer fingers, dilated finger tips, well-developed subarticular tubercles, and parotoid glands. *Pedostibes* has marked arboreal tendencies.

#### KEY TO ADULT *Ansonia*

- 1A. Tympanum not visible externally . . . . . 12
- 1B. Tympanum visible . . . . . 2
- 2A. First finger not reaching disk of second when fingers are adpressed (fig. 81, A, B) . . . . . 3
- 2B. First finger reaching disk of second (fig. 81, C) . . . . . 9
- 3A. Sharp tarsal ridge present . . . . . 4
- 3B. No tarsal ridge . . . . . 5
- 4A. A white spot below eye; a whitish band from eye to arm (fig. 82, A).  
*albomaculata*
- 4B. Without above pattern (fig. 82, B) . . . . . *minuta*
- 5A. Abdomen with large yellow areas . . . . . 6
- 5B. Abdomen without large yellow areas . . . . . 7
- 6A. Upper lip barred with yellow . . . . . *malayana*
- 6B. Upper lip uniformly dark . . . . . *ornata*
- 7A. Tips of outer fingers broadened into spatulate disks (fig. 81, A) . . . . . 8
- 7B. Tips of outer fingers rounded (fig. 81, B) . . . . . *malayana*
- 8A. Distance between tympanum and mouth half or less than half of the distance between nostril and mouth . . . . . *platysoma*
- 8B. Distance between tympanum and mouth more than half of the distance between nostril and mouth . . . . . *hanitschi*
- 9A. At least two phalanges of third and fifth toes free of web (fig. 83, A).  
*leptopus*
- 9B. Less than two phalanges of third and fifth toes free of web (fig. 83, B) . . . 10
- 10A. Abdomen dark, with small light spots . . . . . *penangensis*
- 10B. Abdomen light, with small dark spots or with light and dark spots of equal area . . . . . 11
- 11A. A pair of longitudinal ridges or rows of tubercles between eyes (fig. 84, A).  
*longidigita longidigita*
- 11B. No such ridges or rows of tubercles (fig. 84, B) . . . . . *longidigita gryllivoca*
- 12A. Males with vocal sacs less than 31 mm., snout-vent; females with convoluted oviducts less than 38 mm. . . . . *muelleri*
- 12B. Males with vocal sacs more than 31 mm.; females with convoluted oviducts over 40 mm. . . . . *mcgregori*



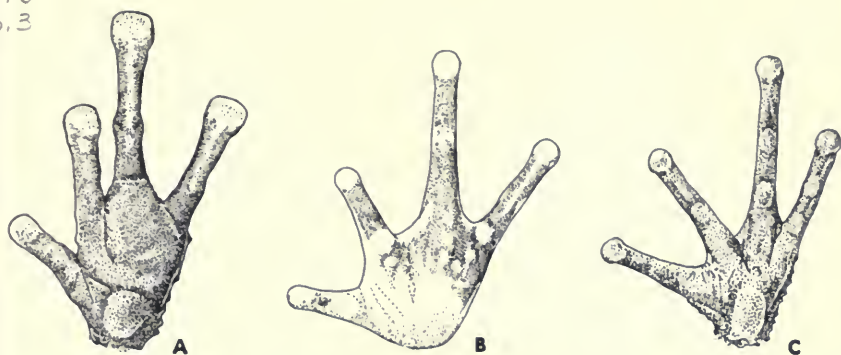


FIG. 81. Ventral views of hands. A, *Ansonia minuta* ( $\times 7$ ). B, *A. malayana* ( $\times 7$ ). C, *A. longidigita* ( $\times 3$ ).

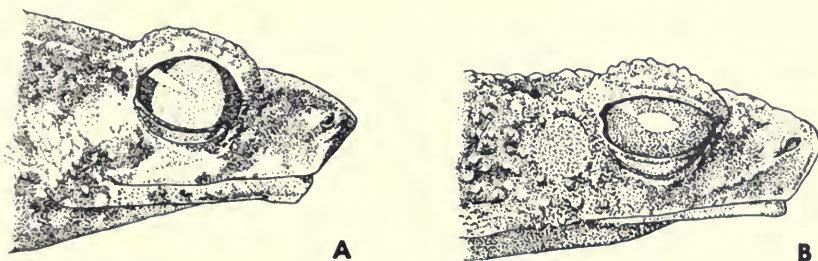


FIG. 82. Side views of heads ( $\times 5$ ). A, *Ansonia albomaculata*. B, *A. minuta*.

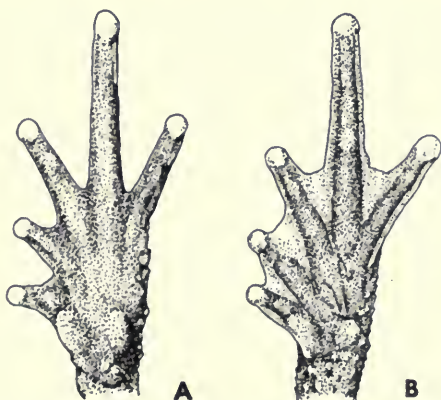


FIG. 83. Ventral views of feet. A, *Ansonia leptopus* ( $\times 3\frac{1}{2}$ ). B, *A. longidigita* ( $\times 2\frac{1}{2}$ ).

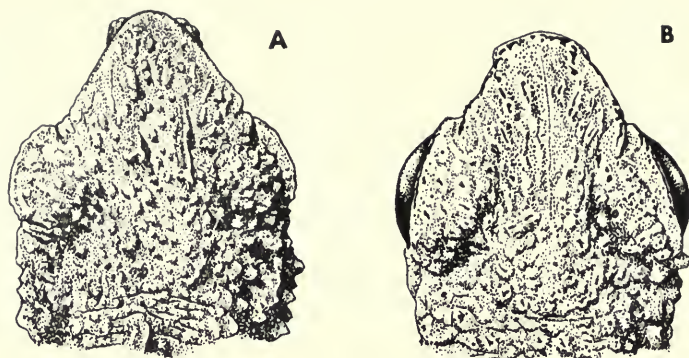


FIG. 84. Dorsal views of heads. A, *Ansonia l. longidigita* ( $\times 3$ ). B, *A. longidigita gryllivoca* ( $\times 3\frac{1}{2}$ ).

### ***Ansonia penangensis* Stoliczka**

*Ansonia penangensis* Stoliczka, 1870, Jour. Asiatic Soc. Bengal, 39: 152—Penang Island.

*Material examined*.—Penang Island, 2 (BM<sup>1</sup>).

*Diagnosis*.—A medium-sized species (mature females 35–40 mm.); tympanum visible externally; finger tips rounded; first finger reaching at least to base of disk of second finger; no longitudinal ridges in interorbital space; about  $1\frac{1}{2}$  phalanges of third and fifth toes free of web; a weak tarsal ridge usually present.

Sides of head, body, and limbs with large pale spots; under side brown with small whitish spots.

*Remarks*.—Both topotypes are females, the larger (37.5 mm.) containing enlarged ova. They differ from the original description only in size, the largest of Stoliczka's toads being 22 mm. Inasmuch as Stoliczka did not give the sex of that specimen, we may assume it to be a male, in which case the size difference between the present series and the types is easily accounted for by sexual dimorphism. The agreement of these specimens with the color notes of the original description is remarkably close.

The toads referred to *penangensis* by Smith (1930, p. 129) belong to another species (*malayana*), described below.

*Range*.—As yet *penangensis* is known only from Penang Island, but it almost certainly occurs in the Malay Peninsula.

### ***Ansonia ornata* Günther**

*Ansonia ornata* Günther, 1875, Proc. Zool. Soc. London, 1875: 568, pl. 63, fig. A—Brahmagiri Hills, Coorg, India.

<sup>1</sup> For explanation of abbreviations see page 503.

*Bufo pulcher* Boulenger, 1882, Cat. Batr. Sal. Brit. Mus., p. 288 (substitute name); 1890, Fauna of Brit. India, Rept. and Batr., p. 501.

*Material examined*.—India, 1 (CNHM).

*Diagnosis*.—A small to moderate-sized species (mature male 27 mm.); tympanum visible externally; finger tips rounded; first finger not reaching disk of second; no longitudinal ridges in interorbital region; web (at least in males) reaching disks of third and fifth toes; no tarsal ridge; lips with alternating bars of yellow and black; large yellow spots on abdomen.

Males with one row of colorless spinules under mandible; a brown nuptial pad on first finger only.

*Remarks*.—*Ansonia ornata* is most like *malayana*. Differences between the two are discussed below.

The most interesting thing about *ornata* is its geographic isolation from its congeners in Malaysia. This disjunct distribution is duplicated by other genera of reptiles and amphibians of Malaysia and peninsular India (e.g., *Pedostibes*, *Draco*, *Cophotis*).

*Range*.—Southwestern peninsular India.

### ***Ansonia malayana*, new species**

*Holotype*.—British Museum number 1900.9.26.16, an adult male collected at 4,000 feet in the Larut Hills, Perak, Malaya, by A. L. Butler.

*Diagnosis*.—A small species of *Ansonia* (females under 30 mm.); tympanum visible externally; finger tips rounded; first finger not reaching disk of second; no interorbital ridges; third and fifth toes webbed to disks in males, with 1-1½ phalanges free in females; no tarsal ridge.

*Description of holotype*.—Habitus moderate; head about as long as broad; snout as long as eye, truncate, projecting, sloping in profile, constricted before eyes; nostril above symphysis; canthus rostralis distinct, rounded (sharper in paratypes); lores straight, vertical; interorbital at narrowest point slightly wider than upper eyelid; tympanum distinct, close to eye, about half diameter of eye.

Fingers slender (fig. 81, B); tips rounded, not wider than rest of fingers; a rudimentary web reaching center of subarticular tubercles of first two fingers; first finger much shorter than second, length of first (measured from median edge of palmar tubercle) equal to diameter of eye; fourth finger longer than second; subarticular tubercles feeble; a low, round outer palmar tubercle. Tips of toes swollen into

small round disks; fifth toe slightly longer than third; broad web reaching disks of all except fourth toe; fourth toe with three phalanges free of broad web, narrow web reaching disk; subarticular tubercles weak; two low metatarsal tubercles; no tarsal ridge.

Skin above heterogeneously tuberculate with small round warts; no cranial ridges or rows of tubercles; warts of limbs spinose; abdomen coarsely granular, throat finely so.

A longitudinal opening into median subgular vocal sac on right side of mouth; a row of pale brown, obtuse tubercles under mandible; a yellowish brown nuptial pad on dorso-medial surfaces of metacarpal and basal phalanx of first finger.

Color (in alcohol) dark brown above marked with greenish yellow, an interrupted light interorbital chevron, a light interscapular spot, and an interrupted light dorso-lateral arc; limbs with yellowish cross-bars; sides of head and body with small yellow spots; below dusky with small yellow spots.

Measurements (in millimeters): snout-vent 20.2; head length (from commissure to lower tip of snout) 6.0; head width 5.9; tibia 9.7; foot 7.8.

*Paratypes*.—BM 1900.9.26.17–20, from the type locality; BM 1921.4.1.290–296 and CNHM 25003, from Chumporn, Thailand; MCZ 8810–11, from Tasan, Thailand.

The Perak specimens are a uniform lot, agreeing with the holotype but differing from the Thai toads. The last have much larger yellow spots on the belly. In fact, the yellow areas are more extensive than the dark areas in the posterior third of the abdomen, whereas in the Perak toads the yellow is present only in the form of small dots. The Thai series also has slightly more extensive webbing in females, the third toe having  $\frac{1}{2}$  or one phalanx free of web (usually  $\frac{1}{2}$ ) and the fifth toe having one phalanx free. In Perak females both toes usually have  $1\frac{1}{2}$  phalanges free of webbing. Males of both series have only the disks of those toes free.

Snout-vent lengths of Perak females range from 24.1 to 27.0 mm. (mean 25.90;  $N=4$ ), of Thailand females 26.2–28.8 (mean 27.47;  $N=7$ ). Three mature males from Thailand measure 21.4–22.8 mm. (mean 22.07). The holotype (20.2 mm.) is the only Perak male.

Despite the differences between the paratype series from peninsular Thailand and the topotypes, the two series are much more similar to one another than either is to any other sample of *Ansonia* examined. This relationship fits the general similarity between the faunas of the Isthmus of Kra and of the lower Malay Peninsula.



*Comparisons.*—Specimens of *malayana* from the Isthmus of Kra are very similar to *A. ornata*. The Indian form is larger (males more than 25 mm.; *malayana* males less than 25 mm.), has a deeper head, and differs in coloration. The top of the head usually bears a large light blotch in *ornata* but not in *malayana*; the upper lip is uniformly dark brown in *ornata* but spotted with yellow in *malayana*; narrow yellow bars cross the upper surfaces of the hind legs in *malayana* but not in *ornata*.

In its small size, short first finger, and sex dimorphism in webbing, *malayana* resembles *minuta* (see below). The two differ sharply in the shape of the finger tips (spatulate disks in *minuta* only) and in the tarsal ridge (present only in *minuta*).

Although the type locality of *malayana* is close to that of *penangensis*, these two species differ in much the same way that the latter differs from *minuta*, i.e., *penangensis* is larger, has longer arms and fingers, and has less webbing between the fingers than *malayana*.

Differences between *malayana* and Bornean species other than *minuta* include size, length of the first finger, and sex dimorphism in extent of web. In addition, both sexes of *malayana* have more webbing than those of *leptopus* and never develop the large dorso-lateral warts occurring in males of *leptopus*.

*Range.*—The Malay Peninsula from the Isthmus of Kra southward.

### *Ansonia leptopus* (Günther)

*Bufo leptopus* Günther, 1872, Proc. Zool. Soc. London, 1872: 598—Matang, Sarawak.

*Bufo spinulifer* Mocquard, 1890, Nouv. Arch. Mus. Hist. Nat. Paris, (3), 2: 160, pl. 11, fig. 6—Mount Kina Balu, North Borneo.

*Ansonia leptopus* Inger, 1954, Fieldiana: Zool., 33: 239.

*Material examined.*—Sarawak 6 (4 BM, including type of *leptopus*; 2 CNHM); North Borneo 5 (2 BM; 3 MHNP, types of *spinulifer*).

*Diagnosis.*—A large species (females 55–60 mm.; males ca. 35 mm.); tympanum visible externally; finger tips rounded; first finger reaching disk of second; mature males usually with conical tubercles in interorbital space; 2–2½ phalanges of third and fifth toes (fig. 83, A) and 3–4 phalanges of fourth toe free of web; no tarsal ridge.

Mature males with three to four rows of black spinules under mandible; a brown nuptial pad on first finger; usually four longi-

tudinal rows of large, spinose tubercles on back. Females without spinose tubercles.

*Remarks.*—The conspicuous variation in tuberculation of the dorsum in the six Sarawak specimens, all of which are from Matang, the type locality of *leptopus*, spans the difference between *leptopus* and *spinulifer* in this character and indicates that the difference between two nominate forms is sexual. The three males composing the type series of *spinulifer*, two other males from Kina Balu, and two males from Matang have dorso-lateral rows of large, elevated warts. The type of *leptopus* is an adult female and has a coarsely granulate dorsum. Two other topotypic females have smoother skin on their backs. An additional Matang male (CNHM 77449) resembles the females in dorsal tuberculation even though it is apparently mature (i.e., vocal sac developed). All specimens, including the type series of *spinulifer*, agree in the reduced webbing; usually the fourth toe has four free phalanges ( $3\frac{1}{3}$  free in one specimen;  $3\frac{2}{3}$  in another).

The juvenile referred to this species previously (Inger, 1956) is actually a *Pedostibes hosi*, as comparison with a large, freshly caught series of young of the latter indicates.

As noted below, the Kina Balu toads identified as *leptopus* by Smith (1931) belong to two other species.

*Range.*—Western North Borneo (Kina Balu area) and Sarawak.

### **Ansonia longidigita longidigita**, new subspecies

*Holotype.*—British Museum number 99.8.19.12, an adult male collected at 4,200 feet on Mount Kina Balu, North Borneo, by R. Hanitsch.

*Diagnosis.*—A large species (mature females 50–65 mm., males 35–49 mm.); tympanum visible externally; finger tips rounded; first finger reaching disk of second; a pair of longitudinal ridges or rows of tubercles in interorbital space; one to two phalanges of third and fifth toes free of web; no tarsal ridge.

*Description of holotype.*—Habitus slender; head slightly broader than long; snout subequal to eye, truncate, constricted before eyes, obliquely sloping in profile; nostril above symphysis; canthus rostralis sharply angular; lores straight, vertical; interorbital at narrowest point wider than upper eyelid; tympanum distinct, about two-fifths horizontal diameter of eye.

Fingers slender (fig. 81, C), long, tips obtuse, swollen but not wider than other phalanges; first finger reaching base of tip of sec-

ond; first finger (measured from median edge of palmar tubercle) equal to distance from front corner of eye to center of tympanum; fourth finger longer than second; subarticular tubercles feebly distinct; a large, round palmar tubercle laterally. Tips of toes (fig. 83, B) similar to those of fingers; fifth toe slightly longer than third; membranous web reaching disk of first toe, disk on both sides of second toe; third toe with  $1\frac{1}{3}$  phalanges free laterally, fifth with  $1\frac{1}{2}$  phalanges free medially, fourth with three phalanges free; subarticular tubercles obscure; two low, roundish metatarsal tubercles; no tarsal ridge.

Skin above with numerous small round warts; a pair of low, irregular, longitudinal ridges on head from posterior interorbital region forward onto snout (fig. 84, A); limbs and ventral surfaces, except throat, coarsely tuberculate; throat finely granular.

A longitudinal opening into the vocal sac on the right side of the mouth; a band of black, conical tubercles under the mandible; a feeble yellowish nuptial pad on dorso-medial surface of first metacarpal.

Color (in alcohol) dark brown above, with indistinct lighter spots; limbs with narrow yellow crossbars; ventral surfaces, except throat, mottled brown and yellow, the two tones occupying equal areas; throat dusky brownish.

Measurements (in millimeters): snout-vent 37.5; head length (from commissure to lower tip of snout) 10.4; head width 11.4; tibia 20.2; foot 14.5.

*Paratypes*.—Sarawak: BM 97.12.30.65–66, Lawas, Fifth Division; Sarawak Museum unnumbered (1), Long Sinei, Akah River, Fourth Division; Sarawak Museum unnumbered (1) and CNHM 96030, Meligong, Akah River, Fourth Division; Sarawak Museum unnumbered (1) and CNHM 81241–43, Lupa River Valley, Second Division. North Borneo: BM 1929.12.22.71–74, 1929.12.22.81, CNHM 22661 (2), MCZ 22615–19, Kenokok, Mount Kina Balu; BM 1929.12.22.82, MCZ 22607–09 (7), Kiau, Mount Kina Balu; MCZ 22610–14 (11), Kadamaian River, near Mount Kina Balu.

The cranial ridges in this sample are extremely variable in conformation though in only one toad from Lawas and in one from the Lupa Valley are they absent. The ridges may be very low and restricted to the interorbital region, or limited to the snout, or broken up into rows of tubercles. But all individuals have a series of low, outwardly radiating ridges above the canthi.

The number of phalanges of the third toe free of web varies from one to two. Usually  $1\frac{1}{2}$  to 2 phalanges of the fifth toe are free,

though two have only one free phalanx. The fourth toe normally has 3-3½ free phalanges.

Two females (51.5, 52.4 mm.) have enlarged ova (1.5 mm. in diameter). The largest female at hand measures 63.7 mm.; seven other females (46.1-49.1 mm.) are apparently immature. Twenty-three males (including the holotype) having vocal sacs measure 35.4-49.4 mm. (mean =  $38.32 \pm 0.79$  mm.); only one is larger than 42.5 mm.

All adult males have a band of dark, spinose tubercles under the lower jaw. These bands are from three to six tubercles wide at the symphysis and taper to two or three tubercles posteriorly. One male (40.1 mm.) has a cluster of similar spinose tubercles on each side of the chest. A small yellowish or brownish nuptial pad is present on the first finger.

*Remarks.*—The Kina Balu specimens (examined in the Paris Museum) assigned to *leptopus* by Mocquard (1890) clearly belong to *longidigita*. Their webbing agrees with the latter's and they have two rows of interorbital tubercles. Half of the material identified by Smith (1931) as *leptopus* belongs to *longidigita* and half is *hanitschi* (see below).

*Comparisons.*—This form differs from *leptopus*, with which it is sympatric on Mount Kina Balu, in the greater extent of webbing, in the presence of the ridges or longitudinal rows of tubercles on the top of the head, and in the absence of enlarged dorso-lateral warts in males.

If the two Penang Island toads are correctly identified as *penangensis*, that species differs from *longidigita* in size (adult females 35 and 50 mm., respectively), in the absence of interorbital ridges or rows of tubercles, and in coloration. *Ansonia penangensis* has rather large pale spots on the head and body and small whitish spots ventrally. *Ansonia longidigita* has no orange or yellow spots on the head or body; ventrally the light spots are equal in size to the dark areas.

The present species is also much larger than the two other Kina Balu forms, *hanitschi* (adult males ca. 25 mm.) and *platysoma* (adult males ca. 22 mm.). The first finger, which in *longidigita* reaches the disk of the second, is relatively much shorter in *hanitschi* and *platysoma*. The last two also lack the interorbital ridges or rows of tubercles found in *longidigita*.

Size and relative lengths of the first two fingers distinguish *longidigita* from *minuta*, *albomaculata*, *malayana*, and *ornata*. The shorter first finger and the hidden tympanum distinguish the Philippine *muelleri* and *mcgregori* from *longidigita*.



*Range*.—From western North Borneo to southern Sarawak.

***Ansonia longidigita gryllivoca*, new subspecies**

*Holotype*.—Chicago Natural History Museum number 77397, an adult male collected in primary forest in the Sungai Tawan, a small tributary of the Kalabakan River, Tawau District, North Borneo, on June 6, 1956, by Robert F. Inger.

*Diagnosis*.—A large form (adult males about 35 mm.); tympanum present, visible; finger tips rounded; first finger reaching disk of second; interorbital ridges weakly developed or absent; usually one phalanx of third and fifth toes free of web (in males); no tarsal ridge.

*Description of holotype*.—Like the nominate form except in the very feeble development of interorbital ridges (fig. 84, B), greater extent of web, and certain secondary sex characters. (See discussion under *Comparisons*, below.)

Skin above heterogeneously tuberculate; all warts small, subconical, and with obtuse, dark, horny tips; tubercles on dorsal surface of head not in linear arrangement; warts on limbs similar to those on dorsum, those on tarsus more spinose; ventral surfaces coarsely granular.

A longitudinal opening into subgular vocal sac on right side of mouth; chin with dark spinules in three rows, under side of mandible laterally with one row; a dark nuptial pad on dorsal and medial surfaces of first finger from center of metacarpal to end of basal phalanx and in a small circular area on second metacarpal.

Color (in alcohol) dark brown above with obscure lighter areas; limbs with broad, dark crossbars; throat dark brown with small, lighter areas; chest and abdomen cream-colored with very faint dark spots.

Measurements (in millimeters): snout-vent 35.1; head length (from commissure to lower tip of snout) 8.9; head width 9.9; tibia 18.6; foot 13.1.

*Paratypes*.—CNHM 77398-420, from the type locality. All are males; snout-vent range is 32.8-38.3 mm. Seven have nuptial pads on the second finger similar to that of the holotype. The nuptial pad is confined to the first finger in the remainder, of which four have pale rather than dark pads. The dark pigmentation of the throat covers the chest also in some individuals, and in these the spotting of the abdomen is conspicuous.

*Comparisons*.—This subspecies differs from *A. longidigita* in the feeble development of interorbital ridges and tubercles, the slightly

more extensive web, and the weaker mandibular tubercles. The number of phalanges of the third toe free of web in the two forms is shown in Table 1.

TABLE 1.—Number of Males of *Ansonia longidigita* Having Stated Number of Phalanges of Third Toe Free of Web

	Phalanges of third toe free			
	$1/2$	1	$1\frac{1}{4}-1\frac{2}{3}$	2
<i>l. longidigita</i> .....	0	11	9	4
<i>l. gryllivoca</i> .....	7	10	1	0

In males of *l. longidigita* the nuptial pad appears on the first finger only, whereas one-third of *l. gryllivoca* males have nuptial spinules on the second finger as well. Development of mandibular asperities shows the reverse relationship. In *l. longidigita* the asperities are broader, higher, sharper, blacker, and more numerous than those of *gryllivoca*. Those of *l. longidigita* may properly be described as black spines, those of *gryllivoca* as blunt cones. The spines of *longidigita* are arranged in 3 to 6 rows at the symphysis, the cones of *gryllivoca* in 1 to 4 rows. The differences in development of these structures would suggest that the males of *gryllivoca* are less mature than those of *longidigita*. But the nuptial pads, usually good indicators of maturity, suggest the opposite. Therefore, the differences between the two forms in these sex characters most likely result from differences in heredity rather than from differences in developmental stage.

Despite these differences *longidigita* and *gryllivoca* are more similar to one another than either is to any other *Ansonia*. This relationship is best expressed by treating them as subspecies.

*Range*.—Known only from the east coast of North Borneo.

### *Ansonia hanitschi*, new species

*Holotype*.—British Museum number 99.8.19.13, an adult male collected at Kadamaian River at 4,200 feet on Mount Kina Balu, North Borneo, by R. Hanitsch.

*Diagnosis*.—A medium-sized species (females about 30–32 mm.; males ca. 26 mm.); tympanum visible externally; finger tips swollen into spatulate disks; first finger not reaching disk of second; no longitudinal ridges in interorbital; third and fifth toes with  $1\frac{1}{2}$ –2 phalanges free of web; no tarsal ridge.

*Description of holotype*.—Habitus moderately slender; head as long as broad; snout longer than eye, truncate, constricted before eyes, obliquely sloping in profile (fig. 85); nostril slightly beyond

symphysis; canthus rostralis sharp; lores straight, vertical; inter-orbital at narrowest point wider than upper eyelid; tympanum distinct, half eye diameter, close to eye.

Fingers slender, tips swollen into spatulate disks wider than other phalanges; a slight but distinct web at base of fingers, reaching base of subarticular tubercle of first finger but not that of second; first finger much shorter than second, length of first (measured from median edge of palmar tubercle) equal to diameter of eye; fourth longer than second; subarticular tubercles obscured; a feeble, round outer palmar tubercle. Tips of toes similar to those of fingers; fifth toe slightly longer than third; web membranous, reaching disks of first two toes; third toe narrowly webbed to disk,  $1\frac{1}{2}$  phalanges free of broad web; fifth toe with two phalanges free of web; broad web leaving three phalanges of fourth toe free and reaching disk as a narrow fringe; subarticular tubercles obscure; two low metatarsal tubercles; no tarsal ridge.

Skin above heterogeneously tuberculate; a pair of small round warts on forehead, a similar pair in interorbital, and a pair of oval ones set obliquely in parietal region; dorso-lateral region with elongate warts; mid-dorsum and dorsal surfaces of limbs with large and small round warts; pectoral and abdominal areas coarsely granulate, gular region finely so.

A longitudinal opening into vocal sac on right side of mouth; a single row of yellowish, spinose, conical tubercles under mandible; a second row of much smaller spicules at symphysis; a dark brown nuptial pad of coarse asperities on dorsal surfaces of metacarpal and basal phalanx of first finger.

Color (in alcohol) above brown with a few oval light spots on back; limbs dorsally with narrow yellow bars; abdomen mottled brown and pale yellow; gular region uniformly brown.

Measurements (in millimeters): snout-vent 26.1; head length (from commissure to lower tip of snout) 7.6; head width 7.5; tibia 13.9; foot 10.9.

*Paratypes*.—All from Mount Kina Balu, North Borneo. BM 99.8.19.14 from the type locality; BM 95.11.7.86 (6), BM 1929.12.22.77–80, MCZ 22621 Lumu Lumu (5,500 feet).

All but one paratype have the small round warts forming three separated pairs on the top of the head. The number of phalanges of the third toe free of broad web varies from one (in two toads) to two (in two toads) with a modal value of  $1\frac{1}{2}$ . Free phalanges of the

fifth toe number  $1\frac{1}{2}$  (in one toad) to  $2\frac{1}{2}$  (in one) with a modal value of two. All have three free phalanges on the fourth toe except a single specimen with  $3\frac{1}{2}$ .

Seven females have a size range of 29.5–31.9 (mean 31.00); only the smallest lacks enlarged, non-pigmented ova. Except for the smallest male (23.3 mm.), the males all have vocal sacs and dark nuptial pads similar to that of the holotype. Size range of these four mature males (including holotype) is 26.1–26.5 mm. (mean 26.28). As in the holotype, the paratype males have a single row of large conical tubercles under the mandible and usually a row of much smaller tubercles at the symphysis. In every case these tubercles are yellowish. The absence of melanic horny material cannot be attributed to a stage of sexual development because the nuptial pads are evidently fully developed and supplied with melanin.

*Remarks.*—As noted above, part of the material identified by Smith (1931) as *leptopus* is included in the paratype series of the present species.

*Comparisons.*—This species is sympatric with *leptopus* and *longidigita* at least on Mount Kina Balu and differs from both in size. Adult females of *hanitschi* are 20 to 30 mm. and adult males 10 to 15 mm. shorter than the corresponding sexes of *leptopus* and *longidigita*. *Ansonia hanitschi* also differs from *leptopus* in having more extensive webbing and from both *leptopus* and *longidigita* in the mandibular tubercles, which are in three to six rows and colored black in the last two species, as compared to one or two rows and yellow color in *hanitschi*. Comparison with the other Kina Balu form, *platysoma*, is made under the heading of the latter species.

*Ansonia hanitschi* is only slightly shorter than *A. penangensis* females at hand (34.4–37.5 mm. in the latter, 29.5–31.9 in the former), but it has a narrower head and a more projecting snout. According to Stoliczka's description (confirmed by the two specimens at hand), *penangensis* has a dark ventral coloration marked with very small white spots each about equal to the size of one ventral granule, whereas in *hanitschi* the white areas of the belly are subequal to the dark. *Ansonia penangensis* apparently lacks the pairs of round warts on the top of the head.

*Ansonia hanitschi* is slightly larger than *minuta*, *malayana*, and *albomaculata* (adult males of last three under 25 mm., of *hanitschi* over 25 mm.), and it differs from the last two in having distinctly spatulate rather than rounded finger tips. It also differs from *minuta* and *albomaculata* in lacking a tarsal ridge.



*Range*.—Known only from 4,200–5,500 feet on Mount Kina Balu, North Borneo.

**Ansonia platysoma**, new species

*Holotype*.—Chicago Natural History Museum number 28213, an adult male, collected at Luidan River near Bundu Tuhan at 3,300 feet on Mount Kina Balu, North Borneo, by J. A. Griswold.

*Diagnosis*.—A small species (adult males 21.5–23 mm.); tympanum visible externally; tips of outer fingers swollen into small spatulate

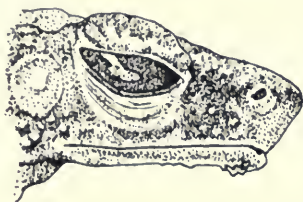


FIG. 85. Lateral view of head of *Ansonia hanitschi* ( $\times 5$ ).



FIG. 86. Lateral view of head of *Ansonia platysoma* ( $\times 5$ ).

disks; first finger not reaching disk of second; no longitudinal ridges in interorbital; third toe usually webbed to disk (in males), fifth toe with  $1-1\frac{1}{2}$  phalanges free of web; no tarsal ridge.

*Description of holotype*.—Habitus very slender; body and head markedly depressed (fig. 86), depth of head less than eye-nostril distance; head (measured to lower tip of snout) longer than wide; snout obtusely pointed, strongly projecting, sloping in profile, constricted before eyes, nostril beyond symphysis; canthus rostralis sharp; lores vertical, straight; interorbital about  $1\frac{1}{2}$  width of upper eyelid; tympanum distinct, close to eye, about half diameter of eye.

Fingers slender, tips of outer fingers weakly dilated into small spatulate disks; a rudimentary web, which reaches centers of basal subarticular tubercles of first two fingers; first finger much shorter than second, length of first (measured from median edge of outer palmar tubercle) barely equal to diameter of eye; fourth finger longer than second; subarticular tubercles feeble; a low, round, outer palmar tubercle; an oval inner one feebly evident at base of first finger. Tips of toes swollen into small round disks; fifth toe slightly longer than third; web membranous, a broad sheet reaching base of disks on outer edge of first two toes; third toe with one phalanx free of broad web; fifth toe with  $1\frac{1}{2}$  phalanges free, fourth with three free;

web continuous to disks of three outer toes as a narrow fringe; subarticular tubercles weak; two low metatarsal tubercles; no tarsal ridge.

Skin above and laterally with low heterogeneous warts; no cranial ridges or rows of tubercles; warts on limbs, especially hind limb, spinose; pectoral and abdominal regions coarsely granular, throat finely so.

A longitudinal opening into vocal sac on left side of mouth; no mandibular spines; a dark brown nuptial pad on metacarpal and basal phalanx of first finger.

Color (in alcohol) dark brown above, no pattern visible; limbs with crossbars dorsally; throat lightly dusted with chromatophores; abdomen mottled, light and dark areas subequal.

Measurements (in millimeters): snout-vent 21.8; head length (from commissure to lower tip of snout) 6.5; head width 6.1; tibia 11.1; foot 8.6.

*Paratypes*.—CNHM 28214–16, MCZ 22620; all from the type locality.

All are adult males having vocal sacs and blackish nuptial pads on the first finger. None, however, has mandibular spines. Snout-vent distance varies from 21.5 to 22.8 mm. The web reaches the base of the disk of the third toe in all; only one phalanx of the fifth toe is free of web.

NHMW, no number, is an adult female from "North Borneo." This specimen, 24.3 mm. long, contains enlarged yellowish ova. The web is not as extensive as in the males, the third toe having one and one-half phalanges and the fifth two phalanges free of web.

*Comparisons*.—The depressed habitus immediately distinguishes this form from its congeners. Four species (*leptopus*, *longidigita*, *hanitschi*, and *platysoma*) are sympatric in the Kina Balu region. *Ansonia platysoma* differs from *leptopus* and *longidigita* in its small size and relatively short first finger. It also lacks the mandibular spines found in males of these large species and of *hanitschi*. The presence of well-developed black nuptial pads is evidence that the absence of mandibular spines is not a reflection of immaturity or of an inactive stage in the reproductive cycle.

As a result of general flattening of the body, the tympanum of *platysoma* is much closer to the mouth than is the case in *hanitschi*. In *platysoma* the tympanum-mouth distance is usually less than

half the nostril-mouth distance, but is more than half the latter distance in *hanitschi*.

From the equally small forms (*minuta*, *albomaculata*, *ornata*, and *malayana*), *platysoma* differs by the more slender habitus, the more projecting snout, and the absence of mandibular spines. It also lacks the bold yellowish markings of *ornata* and *malayana* and the sharp tarsal ridge of *minuta* and *albomaculata*. The somewhat larger *muelleri* has much more extensive webbing than *platysoma* and, unlike the latter, has the tympanum hidden under the skin. *Ansonia penangensis* is larger, has a shorter snout and longer fingers than *platysoma*.

*Range*.—Recorded only from about 3,300 feet on Mount Kina Balu, North Borneo.

### *Ansonia albomaculata*, new species

*Holotype*.—Chicago Natural History Museum number 81975, an adult male collected in primary forest, at 1,400–2,000 feet above sea level, in the headwaters of the Baleh River, Third Division, Sarawak, in August, 1956, by Neville S. Haile.

*Diagnosis*.—A small species (males 20–25 mm.); tympanum visible externally, though somewhat obscured by skin; finger tips rounded; first finger not reaching disk of second; no interorbital ridges; third and fifth toes webbed to disks in males; a weak tarsal ridge; a light spot below eye, an oblique light band from eye to arm (fig. 82, A).

*Description of holotype*.—Habitus slender; head wider than long (measured to lower tip of snout); snout truncate, sloping in profile, very slightly constricted before eyes; nostril above symphysis; canthus rostralis sharp; lores vertical, straight; interorbital about  $1\frac{1}{2}$  width of upper eyelid; tympanum partially hidden by skin, close to eye, one-third diameter of eye.

Fingers slender, tips round, not wider than basal phalanges; a rudimentary web reaching bases of subarticular tubercles of first two fingers; first finger shorter than second, length of first (measured from median edge of palmar tubercle) equal to diameter of eye; fourth finger longer than second; subarticular tubercles weak; a low, round outer palmar tubercle. Tips of toes forming small, round disks; fifth toe longer than third; web membranous, as a broad sheet reaching disks of all but fourth toe; fourth broadly webbed to distal subarticular tubercle, narrowly webbed to disk;

subarticular tubercles weak; two low metatarsal tubercles; a distinct ridge along inner margin of tarsus.

Skin above uniformly tuberculate with small, round warts; posteriorly most of warts with a small, spinose tip; no cranial ridges or rows of tubercles; warts of limbs very small, spinose; abdomen coarsely granular, throat and chest finely granular.

A longitudinal opening into median subgular vocal sac on right side of mouth; under side of mandible without spinose tubercles; yellowish brown nuptial pad on dorsal surface of first finger covering distal half of metacarpal and basal phalanx.

Color (in alcohol) above brown with an obscure darker pattern (see under *Paratypes*, below); limbs with narrow light crossbars; a white subocular spot; a white oblique band from rear of eye to arm, crossing antero-ventral corner of tympanum; below whitish with dark net-work, the latter much denser on throat.

Measurements (in millimeters): snout-vent 21.8; head length (from commissure to lower tip of snout) 5.7; head width 6.4; tibia 11.8; foot 7.8.

*Paratypes*.—All from Sarawak. CNHM 81976-77, and Sarawak Museum unnumbered (6), from the type locality; CNHM 81974, and Sarawak Museum unnumbered (2), Lupar River Valley, Second Division; Sarawak Museum unnumbered (1), Sungai Patah, tributary of Baram River, Fourth Division; Sarawak Museum unnumbered (4), CNHM 96026-27, Meligong, Akah River, Fourth Division; Sarawak Museum unnumbered (3), CNHM 96028-29, Long Sinei, Akah River, Fourth Division.

All but one (13.3 mm.) are adult males, as they have vocal sacs and nuptial pads. Twelve have the vocal sac opening on the left side and twelve have it on the right.

Toads from the Fourth Division are slightly larger (snout-vent 23.1-25.4 mm., mean 24.5) than the others (snout-vent 20.9-24.1 mm., mean 22.7) and have less dark pigment ventrally.

The dark dorsal pattern when most distinct consists of an open-centered triangle between the eyes, with corners on the eyelids and occiput. Running caudally from the triangle is an obscure dark streak that sends off paired branches laterally twice. The white subocular spot and postocular streak are present in all adults.

*Larvae*.—Three bufonid tadpoles (fig. 87, CNHM 83019; Sarawak Museum unnumbered) having the distinctive characters of *Ansonia* were collected in a small rocky tributary of the Akah River near



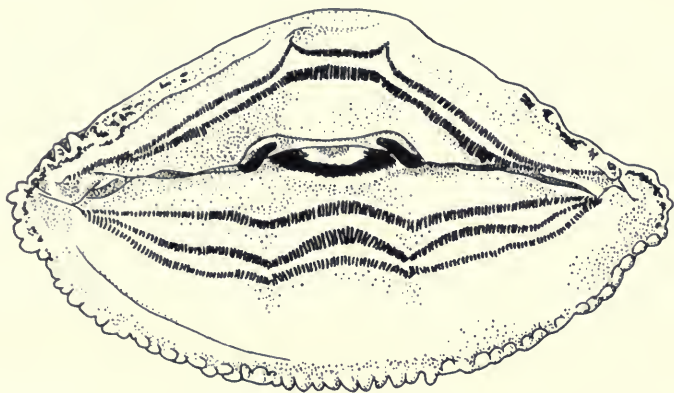
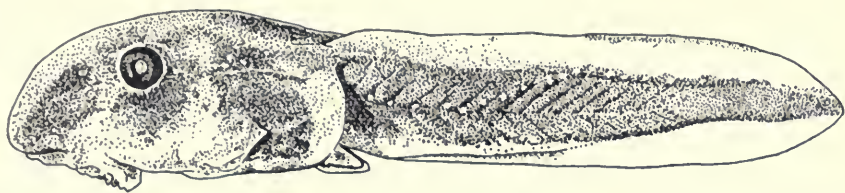


FIG. 87. Larva of *Ansonia albomaculata*. Above, lateral view ( $\times 10$ ). Below, oral disk ( $\times 30$ ).



A



B

FIG. 88. Dorsal views of larvae ( $\times 6$ ). A, *Ansonia* sp. B, *A. albomaculata*.

Long Sinei, Sarawak. Because they are only in early stages of limb development, their specific identity is in doubt. However, adults of *A. albomaculata* were collected at the same spot, and the tadpoles probably belong to that species. Their small size (total length 10.4–13.6 mm.) is supporting evidence, for larvae of *muelleri* at comparable stages measure 19.5–25.5 mm. Adult *muelleri* are 5–10 mm. longer than *albomaculata*. *Ansonia longidigita* certainly and *A. leptopus* probably occur in the Baram basin (of which the Akah River is part). Since they are 10–15 mm. longer than *muelleri* as adults, it is reasonable to expect their larvae to be at least as long as those of *muelleri* and hence much longer than the present three.

*Description of tadpoles.*—Body oval, depressed, eye dorso-lateral, not visible from below; interorbital and internarial spaces subequal; eye-nostril distance shorter than eye diameter; spiracle sinistral, low on side, closer to root of hind limb than to eye; vent median; tail bluntly rounded, margins subparallel; fins not as deep as caudal muscle in proximal two-thirds.

Oral disk equal to width of body; a single row of short, thick papillae on margin of posterior lip, extending on to lateral corners of anterior lip; no inframarginal papillae; labial teeth in all II/III, the rows subequal and almost as long as width of disk; anterior beak divided, the halves separated by  $1\frac{1}{2}$  to 2 times the length of one half; posterior beak angulate; both beaks cream-colored near bases only.

Color (in alcohol) black above, white below; a transverse light band across top of head immediately before eyes (fig. 88, B); a second transverse light band a short distance behind eyes, widely interrupted mid-dorsally; a longitudinal light band from snout intersecting anterior transverse band; a short vertical light bar at root of tail; caudal muscle black except for white stripe mid-ventrally in proximal two-thirds; fins colorless except for light dusting of melanophores at origin of dorsal fin and posteriorly along its margin.

Stages III to IX (Taylor and Kollros, 1946): These tadpoles differ from those attributed to *minuta* (fig. 90) in having a light pattern on the dark dorsal ground color, in having the halves of the anterior beak a little closer together, and in lacking inframarginal papillae. From tadpoles of *Ansonia* sp. (see below, p. 501 and figs. 88, A; 91), they differ in color pattern, in having the pieces of the anterior beak more widely spaced, and in lacking inframarginal papillae.

*Comparisons.*—*Ansonia albomaculata*, though it is about the same size as *minuta* and like the latter has a tarsal ridge, differs from *minuta* in coloration (fig. 82). The latter never has a light post-ocular stripe and has distinct yellow spots laterally and ventrally. The tympanum, which is partially obscured by the skin in *albomaculata*, is distinctly superficial and larger in *minuta*. Finally, the two differ in the shape of the finger tips.

Its small size and tarsal ridge distinguish *albomaculata* from *leptopus*, *penangensis*, and *longidigita*. Of the small species, *muelleri* differs from *albomaculata* in lacking an externally visible tympanum. Though *muelleri* sometimes has a light streak between eye and arm, the stripe is always horizontal and very thin. *Ansonia hanitschi* and *A. platysoma* lack the tarsal ridge and have less extensive webbing. *Ansonia malayana* and *A. ornata* lack the tarsal ridge and also differ in coloration.

*Range.*—Rejang (of which Baleh River is a major tributary), Lupar, and Baram river basins of Sarawak.

### *Ansonia minuta*, new species

*Holotype.*—Chicago Natural History Museum number 77424, an adult male collected in primary forest at 450 feet above sea level, at Matang, First Division, Sarawak, on July 26, 1956, by Robert F. Inger.

*Diagnosis.*—A small species (males 20–24 mm., females under 30 mm.); tympanum visible externally; finger tips spatulate; first finger not reaching disk of second; no interorbital ridges; third and fifth toes webbed to disks in males, 1–2 phalanges free in females; a distinct tarsal ridge; no light band from eye to arm.

*Description of holotype.*—Habitus moderately slender; head (fig. 82, B) slightly wider than long (measured to lower tip of snout); snout truncate, projecting, sloping in profile, constricted before eyes, nostril above symphysis; canthus rostralis sharp; lores vertical, weakly concave; interorbital at narrowest point about  $1\frac{1}{3}$  width of upper eyelid; tympanum distinct, close to eye, about half diameter of eye.

Fingers slender (fig. 81, A), tips distinctly expanded into small spatulate disks wider than basal phalanges; a rudimentary web that reaches bases of subarticular tubercles of first two fingers; first finger much shorter than second, length of first (measured from median edge of palmar tubercle) equal to diameter of eye;

fourth finger longer than second; subarticular tubercles feeble; a low, round outer palmar tubercle. Tips of toes swollen into small round disks; fifth toe slightly longer than third; web membranous, as a broad sheet reaching disks of all toes but fourth (fig. 89); fourth toe broadly webbed to distal subarticular tubercle, a broad flap beyond that point to disk; subarticular tubercles weak; two

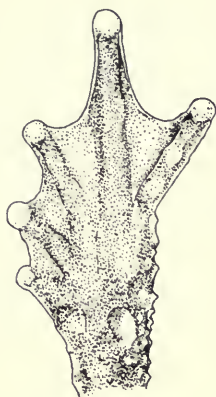


FIG. 89. Ventral view of foot of *Ansonia minuta* ( $\times 5$ ).

low metatarsal tubercles; a distinct ridge along inner margin of tarsus.

Skin above heterogeneously tuberculate; all warts rounded and small, the larger of them with a few obtuse tubercles surrounding a central cone; no cranial ridges or rows of tubercles; warts of limbs spinose; pectoral and abdominal areas coarsely granulate, throat finely so.

A longitudinal opening into median subgular vocal sac on left side of mouth; under side of mandible without enlarged tubercles, but with several rows of small yellowish tubercles; no nuptial pad.

Color (in alcohol) grayish brown, somewhat darker areas surrounding larger warts; limbs with narrow light bars; throat dark brown, immaculate; rest of venter pale yellowish white with irregular dark markings in pectoral region; small yellow spots on sides and abdomen.

Measurements (in millimeters): snout-vent 22.8; head length 6.5; head width 7.0; tibia 12.4; foot 9.1.

*Paratypes*.—CNHM 77421–23, 77425–48, collected at the type locality, July 19–28, 1956.

All males have vocal sacs and small yellowish tubercles under the mandibles but no nuptial pads. Fourteen (including holotype) have



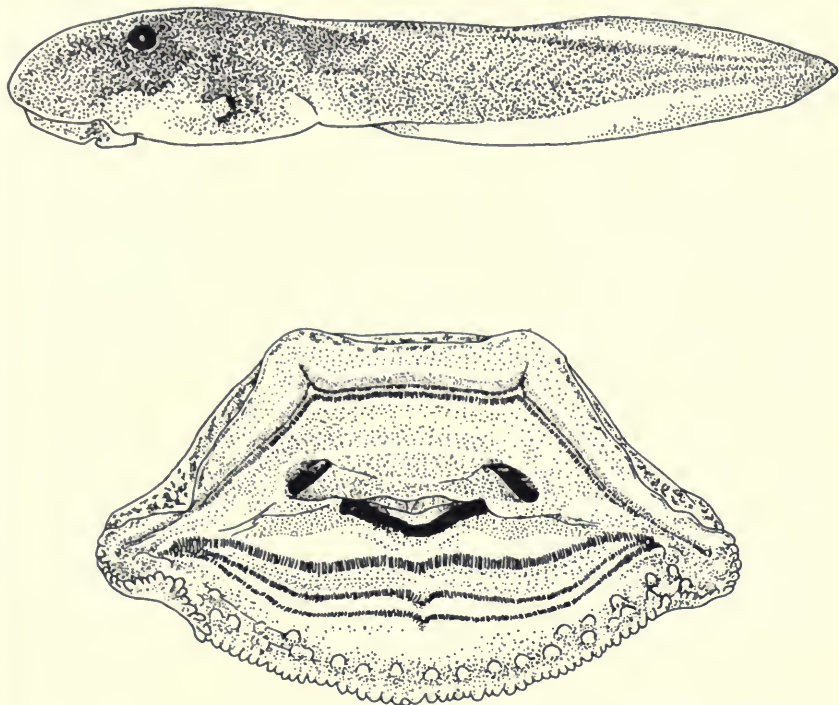


FIG. 90. Larva of *Ansonia minuta*. Above, lateral view ( $\times 6$ ). Below, oral disk ( $\times 20$ ).

a snout-vent range of 21.0–23.2 mm. (mean  $22.14 \pm 0.19$ ). Twelve females range in size from 22.8 to 26.4 mm. (mean  $24.39 \pm 0.29$ ). Four (22.8–26.4 mm.) have enlarged ova.

Although the dorsal pattern is obscure, it resembles that of the holotype, with the darker areas in some toads combining to form posteriorly radiating stripes.

As noted in the diagnosis, males have more extensive webbing. Whereas in females one phalanx of the third toe and 1–2 phalanges of the fifth are free of broad webbing, in males these toes are broadly webbed to the disks.

*Larvae*.—Approximately 60 young tadpoles (fig. 90), with hind limb buds not yet in foot paddle stages, were collected in the same locality as adults of *minuta*. *Ansonia leptopus* is the only other member of the genus known from Matang. As these larvae (total length to 17.2 mm.) are slightly smaller than those of *muelleri*

(see below), which is much smaller than *leptopus*, it is likely that they are the young of *minuta*. These tadpoles are typical of *Ansonia* and in the following description only those points in which they differ from *albomaculata* larvae are mentioned.

*Description of tadpoles.*—Eye-nostril distance shorter than eye diameter, about one-third of interorbital; marginal papillae of lower lip extending onto lateral sixths of anterior lip; two rows of large inframarginal papillae on posterior lip, the outer series continuous, the inner widely interrupted medially; labial teeth II/III; anterior beak divided, the halves separated by twice the length of one half; color of body and tail uniformly blackish above, colorless below; dorsal fin black; ventral fin colorless proximally, margin black in distal half.

*Comparisons.*—The small size and spatulate finger tips distinguish *minuta* from *leptopus*, *longidigita*, and *penangensis*. Among the small and moderate-sized species only *minuta*, *albomaculata*, and *muelleri* have tarsal ridges. The last is easily distinguished by the lack of a superficially visible tympanum and *albomaculata* by the light spot and stripe on the side of the head.

*Range.*—Recorded only from Matang in western Sarawak.

### **Ansonia muelleri** (Boulenger)

*Bufo muelleri* Boulenger, 1887, Ann. Mag. Nat. Hist., (5), 20: 52—Mindanao.

*Ansonia muelleri* Inger, 1954, Fieldiana, Zool., 33: 242, figs. 41–43 (part).

*Material examined.*—Mindanao, 395 (1 BM, type of *muelleri*; 184 plus larvae CNHM; 210 SU).

A collection<sup>1</sup> of approximately 300 *Ansonia* from Mount Malindang, Zamboanga Province, Mindanao, contains two forms differing in size and the extent of webbing. Females of the “small form” become mature (oviducts convoluted, ova enlarging) around 29 mm. snout-vent, the size range (Table 2) being 28.7–34.6 mm. (N=51). Males having vocal sacs varied from 25.5 to 29.6 mm. (N=36). Five adult females of the “large form” measured 42.5–50.1 mm.; three females, 38.3–39.2 mm., had thin, straight oviducts and were probably immature. Adult males (with vocal sacs) of the “large form” measured 32.3–37.2 (N=15); three males, 28.5–32.6 mm., lacked vocal sacs and were presumed to be immature. There is, thus, no overlap between the size ranges of the two forms in either sex.

<sup>1</sup> I am grateful to Dr. Walter C. Brown, Natural History Museum, Stanford University, for permission to study this sample, obtained by him with the aid of a grant from the United States National Science Foundation.

TABLE 2.—Size-Frequency Distribution of Three Samples of *Ansonia* from Mindanao

	<i>Males with vocal sacs</i> (Snout-vent, mm.)															
	25	26	27	28	29	30	31	32	33	34	35	36	37			
Mt. Malindang, "small" ( <i>muelleri</i> ).....	..	7	11	17	0	1	..	..	..	..	..	..	..	..	..	..
Mt. Malindang, "large" ( <i>megregori</i> ).....	..	..	..	..	..	..	..	1	0	4	3	4	3	..	..	..
Davao Province ( <i>muelleri</i> ).....	3	3	3	10	10	5	1	..	..	..	..	..	..	..	..	..
	<i>Females with convoluted oriducts</i> (Snout-vent, mm.)															
	29	30	31	32	33	34	35	36	37	43	44	45	46	47	48	49
Mt. Malindang, "small" ( <i>muelleri</i> ).....	3	6	11	11	10	9	1	..	..	..	..	..	..	..	..	..
Mt. Malindang, "large" ( <i>megregori</i> ).....	..	..	..	..	..	..	..	..	..	1	1	2	0	0	0	1
Davao Province ( <i>muelleri</i> ).....	..	2	3	3	4	3	3	3	0	1	..	..	..	..	..	..

TABLE 3.—Altitudinal-Frequency Distribution of Three Samples of *Ansonia* from Mindanao

	<i>Feet above sea level</i>															
	2400	2700	3000	3300	3600	3900	4200	4500	4800	5100	5400	5700	6000	6300		
Mt. Malindang, "large" ( <i>megregori</i> ).....	22	0	4	0	6	4	..	..	..	..	..	..	..	..	..	..
Mt. Malindang, "small" ( <i>muelleri</i> ).....	..	..	..	..	..	13	21	32	7	46	46	40	4	1	..	..
Davao Province ( <i>muelleri</i> ).....	..	81	15	..	..	..	2	..	..	..	..	..	..	..	..	8

The two size groups had different altitudinal distributions (Table 3). As increasing elevation, with its concomitant climatic changes, might affect size attained directly in the absence of genetic differences, females of the "small form" were separated into two altitudinal groups and the size-frequency distributions compared (Table 4).

TABLE 4.—Size-Frequency Distributions of Two Altitudinal Groups of Mature Females of "Small Form" *Ansonia* from Mount Malindang, Zamboanga

Elevation	Snout-vent (mm.)						
	29	30	31	32	33	34	35
4000-4900 feet. . . . .	3	3	7	2	2	1	0
5000-5900 feet. . . . .	0	3	4	9	8	8	1

Within these 2,000 feet of elevation, the "small form" females were larger at higher elevations than at lower ones. As this trend reverses that of the two size forms, it is reasonable to assume that the size difference between the low-altitude (2300-4000 feet) and high-altitude (4000-6300 feet) forms is genetic and not a general effect of environmental differences.

The two forms also differ in the extent of webbing. The first three toes on both sides and the fifth toe on its inner margin are fully webbed to the disks in females of the large, low-altitude form. In females of the small, high-altitude form the first three toes are usually webbed to the disks on the outer edge, although the third toe may have one phalanx free of web. On the inner margins, the third toe has two phalanges free and the second toe one. The fifth toe usually has one or one-half phalanx free. The fourth toe of the large females normally has two phalanges free, whereas in the small females that toe has  $2\frac{1}{2}$  to three free (Table 5). The absence of altitudinal variation in webbing in the small females (Table 5) suggests that the difference between the two forms is genetic and not environmental. Analogous differences occur in males.

The length of the tibia and foot and the width of the head, all relative to snout-vent, were determined for adults of both size forms. The body proportions of the two forms (treating each sex separately) were compared by means of the Mann-Whitney U test; only the relative lengths of the tibia differed significantly ( $P < 0.05$ ). The tibia lengths for males were: "large form," 0.452-0.494 (median 0.477;  $N=12$ ); "small form," 0.478-0.534 (median 0.497;  $N=10$ ).



TABLE 5.—Frequency Distribution with Respect to Webbing on the Fourth Toe in Samples of *Ansonia* from Mindanao

	Phalanges free of webbing								
	1	1⅓	1½	1⅔	2	2⅓	2½	2⅔	3
<i>Males</i>									
Mt. Malindang, "small" ( <i>muelleri</i> ).....	1	0	2	1	11	2	4	2	5
Mt. Malindang, "large" ( <i>mcgregori</i> )....	8	3	2	1	1	..	..	..	..
Davao Province ( <i>muelleri</i> ).....	8	5	6	6	5	..	..	..	..
<i>Females</i>									
Mt. Malindang, "small" ( <i>muelleri</i> ).....	..	..	..	..	..	13	5	40	
Mt. Malindang, "large" ( <i>mcgregori</i> ).....	..	1	1	7	1				
Davao Province ( <i>muelleri</i> ).....	..	..	..	..	4	2	0	4	
<i>Females of "small form"</i>									
Mt. Malindang, 4000–4900 feet.....	..	..	..	..	..	5	2	17	
Mt. Malindang, 5000–5900 feet.....	..	..	..	..	..	8	3	22	

For females the proportions were: "large form," 0.436-0.506 (median 0.461; N=5); "small form," 0.485-0.517 (median 0.507; N=9).

The two size forms thus behave as distinct species, differing in altitudinal distributions and in several characters whose variation is independent of altitudinal effects. The two forms were caught together by Dr. Brown's field party at 4,000 feet above sea level on Mount Malindang (SU 19360-76). If one assumed that the two forms were variants of a single species, a peculiar phenomenon would need explanation. For under that assumption, one would find much greater individual variation (bimodal curves, in fact) in size, webbing, and limb length among 17 toads at 4,000 feet than one would find in specimens from either 1,600 feet below or 2,000 feet above that level. One is forced to adopt the simpler interpretation, namely, that two species are involved.

Two toads have been described from Mindanao: *Bufo muelleri* Boulenger and *B. mcgregori* Taylor. The type of the former, unfortunately with the locality "Mindanao," was an adult male (with vocal sacs) measuring 30 mm. (Boulenger, 1887) and thus agreeing with the "small form" from Mount Malindang. The type of *mcgregori*, from Pasonanca, Zamboanga Province, was an adult male 37 mm. long, falling in the size range of the "large form." In a previous publication (Inger, 1954), *mcgregori* was placed in the synonymy of *muelleri*, an action that now appears erroneous.

Designation of the two forms as *muelleri* and *mcgregori* is complicated by characteristics of a large series from Mounts Apo and McKinley, Mindanao, listed in Tables 2-5 as the "Davao Province" sample. These toads, which in size (Table 2) agree with Mount Malindang *muelleri*, have an altitudinal range roughly equal to the sum of the ranges of both species on Malindang (Table 3). Davao males have webbing similar to that of males of Malindang *mcgregori*, though with more variation; females have webbing like that of Malindang *muelleri*, though again with more variation. The most likely interpretation of these observations is that, in the absence of *mcgregori*, *muelleri* is able to extend its altitudinal range as well as its range of morphological variation.

*Diagnosis*.—A moderate-sized species (males 25-30 mm.; females 30-37 mm.); tympanum not visible externally, partially covered by cranial musculature; tips of fingers rounded, not wider than rest of phalanges; first finger not reaching disk of second; no interorbital ridges; a distinct tarsal ridge.

Third toe webbed to disk or with one phalanx free in females, webbed to disk in all males; fifth toe with one phalanx free in females, webbed to disk in males; for webbing of fourth toe see Table 5.

Light bars on thighs and tibia usually narrower than half of the width of the dark bars.

Adult males have a yellowish or whitish nuptial pad on the first finger. Two or three weak tubercles may be present under the mandibles. Males are smaller than females (Table 2); mean snout-vent lengths are, respectively,  $27.33 \pm 0.13$  mm. (N=68) and  $32.18 \pm 0.20$  mm. (N=70).

*Larvae*.—The tadpoles described in detail elsewhere (Inger, 1954), were correctly assigned to *muelleri*. They differ from those described under *albomaculata* and *minuta* in the division of the beaks and in the arrangement of the papillae of the lips. The marginal papillae extend over almost the entire length of the anterior lip in *muelleri* tadpoles, but only along the lateral fifth or sixth in *minuta*. The large infra-marginal papillae of the posterior lip form one continuous row in *muelleri*, a short half row in *albomaculata*, and one complete plus one interrupted row in *minuta*. Only in *muelleri* is the posterior beak divided. The anterior beak is divided into widely separated halves in *muelleri* and *minuta* and into narrowly separated halves in *albomaculata*.

*Range*.—Mindanao, from Zamboanga to Davao.

**Ansonia mcgregori** (Taylor)

*Bufo mcgregori* Taylor, 1922, Philippine Jour. Sci., 21: 182, pl. 4, figs. 2-3—Pasonanca, Zamboanga, Mindanao.

*Material examined*.—Mindanao, 44 (1 CNHM; 7 MCZ, including 6 paratypes; 36 SU).

*Diagnosis*.—A large species (males 32-39 mm., females 43-50 mm.); tympanum not visible externally, partially covered by cranial muscles; tips of fingers rounded, not wider than rest of phalanges; first finger not reaching disk of second; no interorbital ridges; a distinct tarsal ridge.

Third and fifth toes fully webbed to disks in both sexes; fourth toe with  $1\frac{1}{2}$  to  $2\frac{1}{3}$  phalanges free in females, with 1 to 2 free in males (see Table 5).

Light bars on thigh and tibia usually at least half of the width of the dark bars.

Adult males have subgular vocal sacs and a small grayish nuptial pad on the first finger. The mandible lacks tubercles. Mean snout-vent length of males is  $35.86 \pm 0.35$  mm. (N=22), of females 45.18 mm. (N=5).

*Range*.—Zamboanga Province, Mindanao.

**Ansonia** sp.

Four larvae (CNHM 77526) having the diagnostic characters of *Ansonia* were caught in swift water of a small tributary of the middle reaches of the Baleh River, Sarawak. Their age (limb bud stages VII to X) makes specific identification doubtful. No adult *Ansonia* were collected in the immediate vicinity, though *albomaculata* occurs in the head-waters of the Baleh. A different species of tadpole is tentatively assigned to *albomaculata* (p. 492). Even tentative identification of the present series must wait until additional, more advanced tadpoles are collected. Description of these tadpoles (fig. 91) follows.

Body oval, depressed, flat below; eyes dorso-lateral, not visible from below; interorbital space longer than internarial; eye-nostril distance equal to eye diameter; spiracle sinistral, low on side, closer to root of hind limbs than to eye; vent median; tail bluntly rounded; edges subparallel; fins less than depth of muscle in proximal half of tail.

Oral disk subequal to width of body; a single row of short, thick papillae on margin of posterior lip extending around corners half way

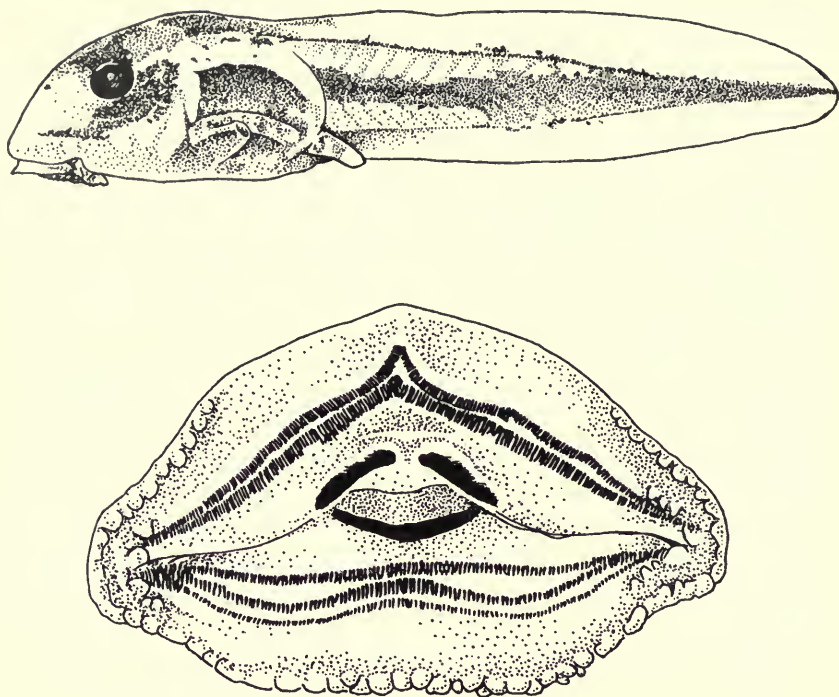


FIG. 91. Larva of *Ansonia* sp. Above, lateral view ( $\times 9$ ). Below, oral disk ( $\times 33$ ).

to center of anterior lip; a single series of six or seven large infra-marginal papillae at each corner of disk, half of them on anterior half of disk; labial teeth in all II/III, the rows subequal and almost as long as width of disk; anterior beak divided, the halves narrowly separated; posterior beak angulate; both beaks cream-colored near bases only.

Color (in alcohol) boldly marked with dark brown and cream, the latter merely the shade of internal organs seen through the transparent skin; a long, brown axial cross consisting of a short, thick interorbital bar and a vertebral stripe beginning at the tip of the snout and continuing along the dorsal edge of the caudal muscle to its tip; a large, rounded dark spot below and behind the eye continued forward on to the snout as a narrow streak not quite reaching the end of the axial stripe; dorsal surface of visceral mass dark brown and appearing from above as a large brown spot on each side of the body behind the suborbital spots; a dark brown stripe mid-laterally



on the caudal muscle, expanding in the distal half of the tail to meet the axial streak; a few melanophores ventrally in abdominal area; otherwise colorless ventrally; fins without pigment, translucent.

Total length 11.3–12.2 mm.; head plus body 4.3–5.1 mm.

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